ASTE

JOURNAL

MAY, 1933

A. S. T. E. Journal

Published by the American Society of Tool Engineers

8316 Woodward Avenue

Detroit, Michigan

William H. Smila, President

Frank Hartlep, First Vice-President
T. B. Carpenter, Second Vice-President
A. M. Sargent, Secretary
Joseph F. Slavik, Treasurer

Published for Members Only

VOL. II MAY, 1933 No. 1

O. B. JONES, Editor

ASSOCIATE EDITORS

A. M. Sargent	Committees
Ford R. Lamb	Meetings
John M. Christman Raymond J. Walter W. J. McKeen	Technical
B. L. Diamond Harold Giller	New Tools and Processes
Guy M. Hartsock	New Dies
Harold Giller B. L. Diamond	New Machines
F. L. Hoffman	Operating Planning
E. R. DeLuiz	News of Industry
Lola Corbin S. R. Read	A.S.T.E. News
F. H. Hartlep	Standards
G. F. Petersimes	Manufacturing Economics
Hans Hansen	Art
C. J. Erickson	Field
O. W. Winter	Foreign Correspondent
William C. Maier	Advertising Manager
Ford R. Lamb	Advertising Representative
Don W. Patterson	Advertising Representative

Owing to the nature of the American Society of Tool Engineers organization, it cannot be responsible for statements appearing in the Journal either as advertisements or in papers presented at its meetings or the discussions of such papers printed herein.

Address all editorial matter, advertisements, and inquiries to A.S.T.E. Journal, 8203 Woodward Avenue, Madison 5048.

COMMITTEES

A. M. SARGENT

At the regular meeting of the A.S.T.E. held in the Detroit-Leland Hotel on April 13th, 1933, the newly installed President, Mr. W. H. Smila, issued a statement naming the Committee heads controlling the activities of the Society for the ensuing year. Many Committee Chairmen were continued in office but several changes were necessary due to the changing of circumstances which have necessitated the resignation of many valuable leaders. The following report gives the names of the Committee Chairmen only; general membership of these committees will be announced at a later date.

Mr. O. B. Jones, as Chairman of the Publications Committee, succeeding Mr. F. R. Lamb who has conscientiously served as Chairman for the past year, has stepped in the harness after serving as a member under Mr. Lamb.

Mr. T. B. Carpenter, Asst. Tool Supervisor of the General Motors Truck Corp., Pontiac, Michigan, succeeds himself as Chairman of the Constitution and By-Laws Committee.

Mr. J. A. Siegel, Asst. Chief Tool Designer of the Packard Motor Car Company, retiring President, succeeds Mr. Earl Ruggles, as Chairman of the Meetings Committee.

Mr. F. L. Hoffman, Tool Engineer of the Packard Motor Car Company, succeeds Mr. W. H. Smila as Chairman of the Membership Committee.

Mr. R. M. Lippard, Detroit Branch Manager of the Heald Machine Company, Worcerter, Mass., has been appointed Chairman of a new Committee called the "Industrial Relations Committee." This Committee is to make an aggressive effort to obtain recognition with industrial plants and their Personnel Managers, to the end of obtaining employment for members of the Society. The work of this Committee will be difficult and will require the cooperation of all Society members who are unemployed, in properly filing applications for assistance by this Committee.

Mr. Floyd Carlson, student of the Detroit College of Applied Science, has been appointed Chairman of a new Committee entitled "Junior Activities Committee." The efforts of this Committee will be to the end of obtaining organized cooperative effort and contacts between Junior and Senior members, and to create activities from which both Senior and Junior members will mutually benefit.

Mr. F. H. Hartlep, Chief Tool Designer of the Timken-Detroit Axle Company, succeeds Mr. E. C. Lee as General Chairman of the Standardization Committee. During the past year considerable effort was made under Mr. Lee's direction to organize and subdivide this work and to obtain capable Chairmen for the various sub-committees. Contacts were made with other Societies conducting standardization work and the various Committee Chairmen for the sub-committees will continue in office.

Mr. L. G. Terbrueggen, Asst. Chief Engineer of the Ex-Cell-O Aircraft & Tool Corp., has been appointed to a newly made position as "Press Agent" for the Society. His activities will extend to getting public notice in newspapers and trade journals.

Mr. Wm. J. Fors, Tool Engineer of the Gray Hub Company, and Mr. J. A. Siegel, Asst. Chief Tool Designer of the Packard Motor Car Company, have been appointed "Official Delegates," of the Society to act as representatives at all meetings of other Societies which are conducting work along the lines attempted by this Society, and to create cooperative effort along professional lines.

PRESIDENT'S MONTHLY MESSAGE

SALES ENGINEERS

Machine and small tool sales engineers are closely allied with the tool engineer and his problems. A great many of our sales engineers have "served their time" as tool engineers and fully realize the problems which daily confront the tool engineer. As soon as an engineer takes up "sales" he becomes a specialist along the line of the products manufactured by the company or corporation which he represents, and his worth to the profession is on the increase.

The problems presented to a tool engineer in the automobile industry during a day are many and varied. He may be dealing with the construction of a chrome plating department; the machining of a new crankshaft, cylinder block or perhaps a complete motor; the method of balancing wheels and tires; the motorizing of the machines in a department; the painting and striping of auto bodies, and hood; the covering of auto springs with metallic covers; and dozens of other problems pertaining to the manufacture and assembly of automobiles. No one man could keep up to date as to the latest developments along all these lines; hence, it then becomes his duty to call in the specialist or sales engineer. These men working with the tool engineer prove the old saying that "two heads are better than one," and in this manner many problems are finally solved.

The sales engineer is as fully dependent upon the tool engineer as the tool engineer is upon the sales engineer, and it is by this mutual aid that progress is made. Every machine and small tool sales engineer should be a member of, and take an active interest in, the A.S.T.E. I, hereby, extend an invitation to every sales engineer, not already a member, to file an application for membership, and I am certain he will be warmly welcomed into our society.

LAST MEETING

The April meeting of the A.S.T.E. was an unusual one, both from the points of view of education and entertainment. The one-hundred-fifty members present had the pleasure of hearing several selections performed by an excellent nine piece dance orchestra. Those members wishing to hear Robert W. Williams and his Troubadours again may do so by tuning in on radio station WJBK Wednesday evenings at 9:15. In appreciation of the favor these up and coming young musicians rendered our Society in contributing their services gratis, allow us to suggest that Society members write personal letters expressing their enjoyment of this weekly radio program to Station WJBK. The services of the Troubadours for any occasion may be had by calling Mr. Robert Williams, Lenox 5415.

The meeting was also featured by our new president's inaugural address. Lack of space prevents us from reproducing his entire talk here. Mr. Smila stressed the importance of the work of the various Committees of the Society, and praised the work done by them in the past year. He also reiterated the stand taken by our retiring president, Mr. Siegel, that our Society is not a union, and in addition pointed out that neither are we an employment agency, although the Society will do all in its power to help bring opportunity to our members if it presents itself. With this end in view, Mr. Smila announced the establishment of an Industrial Relations Committee, whose work will consist in maintaining a file of all members seeking employment and all members seeking employees. Mr. Robert Lippard, Detroit Manager of the Heald Machine Company, was named as the Chairman of this Committee.

The speaker for the evening was Mr. L. A. Danse, of the Cadillac Motor Car Company. He spoke of the demands made upon the metallurgist by modern manufacturing problems. The importance of sound metallurgical specifications was strikingly brought out, through illustrations of the trouble that could proceed from improper specifications.

All in all, it was a most worthwhile and profitable evening, and it is to be hoped that more members will avail themsevles of the advantages offered by these excellent meetings in the future.

NEXT MEETING

NEXT REGULAR MEETING THURSDAY, MAY 11, 1933
AT DETROIT LELAND HOTEL, MAIN BALL ROOM—EIGHT O'CLOCK

SPEAKER: Mr. Harry C. Heffner. SUBJECT: "Detroit and Its Future in the New Era"

PICTURE SUBJECT: "The Uses and Abuses of Twist Drills." Courtesy of Chas. A. Strelinger Co., Detroit distributor for Cleveland Twist Drill Co.


Harry C. Heffner

To all who attend this meeting will be presented the "Handbook for Drillers," a valuable little book published by the Cleveland Twist Drill Company, containing helpful hints in the grinding and use of twist drills, also tables of speeds and feeds and data on all cutting compounds and lubricants. The gift of these handbooks and the presentation of the picture subject have been brought about through the efforts of Mr. H. A. Bokram, Detroit representative and his staff, who are members of the A.S.T.E.

The speaker for the evening, Mr. Harry C. Heffner, is in great demand as a Chautauqua lecturer and as a speaker at conventions, sales meetings, business clubs, and banquets. He is a former Chamber of Commerce president and bank official.

—ANNOUNCEMENT—

June Meeting

Mr. Jacob Wohlfeld, member of the A.S.T.E., will present a very interesting picture subject and lecture on the "Industrial Life of Russia." Mr. Wohlfeld has recently traveled through Russia and is very well qualified to show and tell us the things we have all wanted to know about Russia.

Chairman J. A. Siegel announces the members who will serve with him on the MEETINGS COMMITTEE. They are

C. H. Reynolds	C. G. Gilbert
Edward Bernier	G. C. Crookston

The Committee promises some very interesting meetings during the summer and fall, and their advice to members is to attend all.

JUNIOR ENGINEERS MEET

A meeting of the Junior members of the A.S.T.E. will be held at the Detroit College of Applied Science, 8203 Woodward Avenue, on Thursday, May 18, at 8:00 P. M. All Junior members are invited to attend, as the evening will be devoted to a general discussion of what they would like to do at these meetings and any activities in which they may want to participate. The activities could include base ball or other sports, an orchestra, contributions to a Junior section of the A.S.T.E. Journal, and a drive to increase the Junior membership of the Society. Any suggestions that will help to make the Junior section of the Society beneficial and interesting will be welcomed.

TECHNICAL

JOHN M. CHRISTMAN RAYMOND J. WALTER W. J. McKEEN

One of the primary motives of the A.S.T.E. is to pass on the knowledge and experience of each member to every other member of the Society.

In doing this it is difficult to find a subject of uniform interest to all. That which is new to one is sure to be only a review of familiar facts to someone else.

The articles in this section may appear very commonplace to some of the members who have the advantage of a technical training or a great deal of experience in the work covered, but we believe the majority of the Society will benefit by reading them and thoroughly familiarizing themselves with the sample problems given, if they are not already familiar with them.

We believe that the tool engineer should certainly possess a knowledge of strength of materials as applied to the design of machines and tools, that he should design scientifically and not by rule of thumb.

Far be it from us to belittle the achievements of the purely practically trained man, but we maintain that he can add greatly to his knowledge of theory by the help of the information he will find in these articles.

DESIGN OF HYDRAULICALLY OPERATED, AUTOMATICALLY CONTROLLED, MULTIPLE SPINDLE HEAD, DRILLING MACHINE

We are attempting in this series of articles to show the inexperienced designer how to proceed with the design of a drilling machine, hydraulically operated. We shall make it as general as we can so that it will fit any average case. We have chosen a drill head to illustrate the process of determining the various elements needed because we feel that the design of most other gear driven machines has to be solved in much the same manner.

If you do not agree with the method we are setting forth here we can only say that it is the method used by one of the largest users of multiple heads in the city, and that it has behind it a fine record of well designed, economically operated, efficient multiple spindle head equipment.

Let us assume that we have to drill a steel casting through two different thicknesses of metal, both faces of which have been machined. There are six ½" holes, equally spaced, in each face, on a 6½" circle as shown in Fig. 1. The first thickness of metal is ½", then there is a space of 1½", and

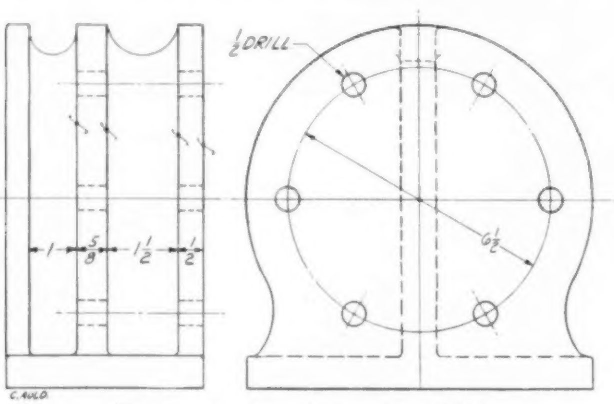


Fig. 1.—Steel casting to be drilled

the second thickness of metal is ⅝". In back of this second thickness of metal is still another thickness of metal that is not to be drilled, so it is necessary that we drill them both from the same side.

We must first determine the size of the gears, the number of teeth in the driving gear and spindle gears, and the strength of teeth required, which will determine the pitch, taking into consideration the face width. Then we have to determine the size of spindles required, the size of the driving shaft, and the speed at which these spindles will have to run.

There are, of course, many other considerations that must be determined before we are finished, such as the amount of pressure required, speed of travel while approaching and retarding, clearance for loading and unloading, horsepower required for driving drills, oil capacity in head, size and thickness of metal for all parts, size and kind of ball bearing required, lubrication of running parts, and other considerations.

We shall start by finding the size gears that we should use. The holes to be drilled are in a circle 6½" in diameter, so we shall try to place our driving spindle exactly in the center with the driving gear on the end of the spindle. Thus we drive all of our spindle gears. We could make our driving gear 3" in diameter and that leaves 3½" for us to make two halves of the spindle gears, or each spindle will be 3½" in pitch diameter. Now it is rarely that we design the spindle gears larger than the driving gear because, as in this case, while each tooth on the spindle gears is contacting a tooth on the driving gear it will be readily seen that the driving gear will get six times as much wear as the spindle gears. The smaller we make this driving gear the more work each tooth must do, so for the sake of efficiency we shall assume that our driving gear is 4" in pitch diameter. That leaves 2½" within the 6½" circle that must be taken up by the spindle gears, or, in other words, the spindle gears will be 2½" in pitch diameter.

We must take care not to make our spindle gears too small, for two reasons; first, we should not have any less than 12 teeth in any standard gear, and, second, we must not get them so small that by the time we have a hole through the gear for the spindle the gear will be unnecessarily weakened.

So, off hand, the driving gear at 4" pitch diameter and the spindle gears at 2½" pitch diameter seem to satisfy our requirements.

(Continued next issue)

STRENGTH OF MATERIALS

By P. F. ROSSMANN*

In previous strength of materials discussions in the Journal, the stresses "tension" and "compression" were defined. The next stress to be considered will be "shear."

Shearing of material is caused by two forces acting in opposite directions in parallel adjacent planes. Several typical examples are shown in Fig. 1, 2, and 3.

It is to be understood that the planes of the two forces are close together. When there is a space intervening, a

*Packard Motor Car Co.

bending action in addition to shearing occurs. This condition, however, will not as yet be considered.

The shearing strength of materials as indicated in tables is the actual force or load in pounds necessary to shear each square inch of section.

In the following problems it is to be considered that the material in question is steel, and that the shearing strength is 50,000 pounds per square inch.

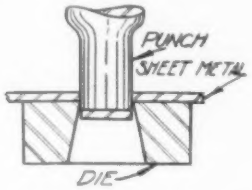


Fig. 1.—Pressure necessary for punching holes.

Problem: As indicated in Fig. 1, how much pressure would be necessary to punch a 1." diameter hole in a sheet of metal .125" thick?

Solution: $3.1416 \times 1. \times .125 \times 50{,}000$ lb. $= 19{,}635$ lb. It follows therefore that a press with a capacity in excess of the piercing pressure should be used.

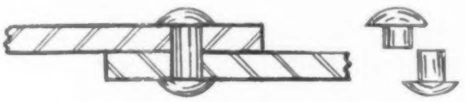


Fig. 2.—Shearing strength of a rivet.

Problem: What is the shearing strength of a .250" diameter rivet under the conditions shown in Fig. 2?

Solution: $3.1416 \times .125 \times .125 \times 50{,}000$ lb. $= 2{,}455$ lb.

Problem: What must be the thickness of the head of a .750" diameter hook bolt in order to sustain a load of 20,000 lb., neglecting the tension factor in the body of the bolt? See Fig. 3.

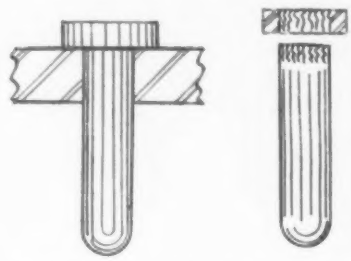


Fig. 3.—Thickness of head of a hook bolt.

Solution:
$$\frac{20{,}000}{3.1416 \times .750 \times 50{,}000} = .170\text{" thick.}$$

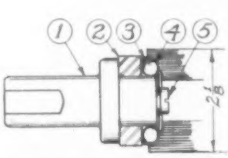
(If further explanation is desired, or if you have any suggestions or criticisms, please feel free to write to the Technical Editors, A.S.T.E. Journal.)

NEW TOOLS AND PROCESSES

B. L. DIAMOND HAROLD GILLER

On this page each month we will show some new tool or device. To do this will require the cooperation of all our readers. You are invited to send us a sketch or blue print and brief description of any new tool or device that you think might prove interesting to the industry.

The proverb, "There is nothing new under the sun," holds true in this profession as well as in any other, but while we may show something which is old to you, it may be new to a majority of our readers.



Tool for finishing a ball race.

The accompanying sketch shows a tool for finishing a ball race. The part is made from bar stock on an "automatic." The rolling is done at the last station, following a finish forming tool. Detail No. 1, the body, is hardened and ground. Detail No. 2, the thrust collar, is of ball race steel, and must be very hard. Detail No. 3 is the ball retainer. Detail No. 4 is the ball. As many balls are used as can be spaced in the retainer. Detail No. 5 is the retainer screw.

This tool is used successfully on both a drill press and an automatic screw machine. A similar tool was used for the opposite race.

CHROMIUM PLATED GAGES

By G. EGLINTON*

This comparatively recent addition to manufacturing processes is being profitably used on many different kinds of tools, the most outstanding results undoubtedly being obtained on gages. Most all manufacturers use chrome plate as a method of salvaging or reclaiming worn out gages, while not many of them specify chrome plate on new gages.

The chrome plate being discussed here must not be confused with "decorative" chrome, which, as its name implies, is used to enhance and preserve the appearance of the article plated. This type of plate is usually applied over initial deposits of copper and nickel plate, whereas hard chrome is applied directly to the job.

The popular idea that chrome is only a "putting on tool" to be used to reclaim worn gages should be dispelled. This idea, of course, has been responsible for the introduction of chrome to users who subsequently recognized its possibilities and took more liberal advantage of its use. In the main, however, it is still only considered as a salvage medium for worn out gages or gages gone "hay wire" in their manufacture. This, of course, is good practice and should be continued, but consideration should also be given to the remarkable wear life of chrome and the economies effected by its use as compared to other materials generally used in fabricating gages.

We are quoting below from a letter received from the chief inspector of one of the largest concerns manufacturing ball and roller bearings. Gaging operations are closely

*Langlois Grinding Company.

followed on this type of work, and gage costs probably are of more importance than in the manufacture of any other product.

"About two and one half years ago we began using chrome plating as a means of reclaiming worn plug gages. The results were so outstanding that for two years we have also specified chrome plating for new gages, having found this procedure more economical because of the greatly increased length of life.

"Many of our bore gaging operations are done while the work is still in the bore grinder. This means that the plug gage is subjected to more than ordinary wear, due to the presence of grinding abrasive in the hole. In addition we must adhere to very narrow limits of size. From 10 mm. to 30 mm. nominal diiameter, a hole tolerance is maintained at .0004". This means that we cannot permit our gages to wear more than .0001" undersize. In spite of these severe conditions of operation we are able to obtain a very satisfactory performance by using chrome plated gages. The following comparison shows the increase in life over our former alloy steel gages:

Alloy steel—1500 to 2000 holes.
Chrome plate—4000 to 5500 holes."

Incidentally, this concern previously used the best plug gages obtainable, which cost approximately 15 per cent less than the plated gages.

An interesting comparison is also offered in the report of results obtained from a plug gage test on piston cross bores. In this test only chrome plated gages were used, having previously proved their advantages, and the test was run to decide which of several sources was submitting the best gages. All gages tried were of uniform accuracy, but varied in quality of finish. Photographs magnified 100 diameters of each gage were taken, and each gage was used under exactly the same conditions. The piston pin hole was .8587" in diameter with a tolerance of +.0005" —.0000". The permissable wear tolerance on the plug was .0001". The gage with the poorest finish, which was in reality an excellent ground gage, lasted for 6,400 pistons, as compared to 78,000 pistons for the best gage, which had a smooth lapped finish. The difference in cost on this job, between the poorest and best gage, was about 35 per cent. This result, of course, justified the specifying of the higher priced gage.

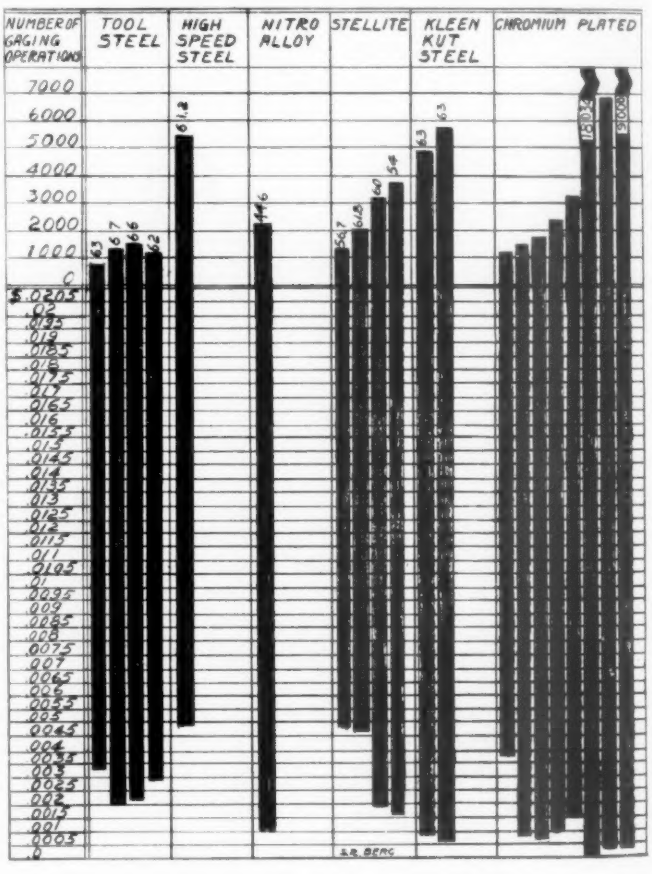
The same conclusion as to the relative value of finish has been reached in all cases observed by the writer, and is well borne out in the chart reproduced here. This chart covers a test run on connecting rods. Several of the best gage steels were used on this job and compared with eight chrome plated gages of various classes of finish. It is interesting to note on this chart that the gage with the longest life more closely approached zero in the cost per hole tabulation than any other. This "cost in operation" should, of course, be the only basis on which to value the gage.

The chrome plate method offers advantages other than long wear. In some instances it contributes considerably toward reducing the first cost of the tool. To illustrate this, an electric refrigerator manufacturer uses an alignment bar to test the squareness of the crankshaft hole with the cylinder bore. This bar is 1.0000" in diameter and 20" long, held to a maximum limit for roundness, straightness, and size of .0001". This job will be recognized by gage makers as difficult, the hardest part being to grind it round within the specified limit. By plating these bars, we are able to use a tough inert steel of low hardness, 50—55 Rockwell, which eliminates most of the tendency for the bar to spring while being ground. Needless to say, the grinding and lapping on this job is performed much easier with the body of the bar in this condition than when it was made of steel throughout.

To secure best results from chrome plating, care should be exercised in the matter of hardness and heat treatment. Many tools and gages have returned from the chrome bath cracked or broken, when no defects were apparent before plating. This result has on several occasions discouraged users from further trials of the process. The only explanation for this is that the defects were present in the form of stresses in the part before plating, and brought out by the electrical disturbance in the chrome tank. Very little heat is used in plating, seldom over 120° F., which, as we know, is not sufficient to distort or set up stresses in any generally used steel. Good practice is to draw all parts to relieve these stresses before plating. This serves two purposes: one is the assurance that the part will not crack in plating; the other, and even more important, is that future distortion is prevented. All of us can recall jobs which have distorted or even broken after being finished without ever having been in service. Mr. Danse ably explained the cause of this in his talk at our recent meeting, and attributed it generally to lack of proper heat treatment, or rather insufficient attention to heat treatment.

Through the use of chrome plating it is possible to have almost positive assurance that these stresses are not present and that distortion will not occur. An excellent example of the advantage of proper care in heat treating was illustrated in the manufacture of piston ring groove gages. These gages were .125" thick, 1½" wide, and about 3" long, with a tolerance of + .000025" to the gage maker. One edge of the gage had a concave radius of about 1¾" to suit the piston diameter. Needless to say, these gages are hard to make. Even the best of gage steels retain some hardening stresses, when hard enough to be practical for this type of gage. The grinding and lapping on this gage must be performed slowly and carefully when it is made of steel, to prevent these stresses causing distortion even while the gage is being made. By using chrome plate on the gaging surfaces of this gage the choice of steel becomes unimportant. Ordinary carbon tool steel hardened and drawn well below its critical hardness became almost totally inert, and, after plating, grinding and lapping were performed faster than on the expensive steel previously used. These plated gages, of course, outwore the steel gages many time, and no distortion appeared, even after the gages were a year old.

Thickness of plate should be determined by the require-



COST PER GAGING OPERATION

A gage used on small end of a connecting rod.

A comparison of new gages made of various materials with chromium plated salvaged gages.

Heavy lines show the average number of pieces gaged during first .00005 wear of gage. Rockwell hardness finding is shown above heavy lines.

The extensions below show the average cost per gaging operation for the first .00005 wear.

ment of the job, and in all cases should be kept down to a minimum. The general practice on salvage and new gages is to grind the gage sufficiently undersize so as to leave from .0015" to .0025" thickness of plate after finishing. The undersize gage is then plated to a thickness of about .005", which is sufficient for final grinding and lapping.

Peeling and chipping on chrome plated surfaces is often traced directly to too great a thickness of plate. The plate itself is very brittle and will not resist impact or any form of abuse as well when heavy as when light plating is used. When the plated parts are subjected to wide temperature variations chipping and peeling are also more frequently noticed. This is probably caused by the expansion of the plated part under heat, resulting in the fracture of the plate. However, chrome has been used safely where just such a danger would seem to exist, on diamond boring bars running in bronze bearings at high speed. These bars were about 30" long with an average diameter of 1⅛", and revolved at 1500 rpm. Due to provision being necessary for fine adjustment on the boring tools in the bar, these bars were costly to make, and plating was resorted to as a salvage medium. The first bars salvaged were purposely plated about .010" thick, in the belief that by providing adjustment on the bronze bearings in which the bar revolved great life would result. The immediate result was ruined bearings caused by fractured plate. These bars were then refinished to leave .001" thickness of chrome and new bearings installed in the machine. The bars then showed a great increase in life over their initial steel surface performance. This would seem to indicate that the thin plate can yield to the expansion of such parts caused by operating friction more readily than heavy plate.

The limited production in manufacturing plants during the past two years has prevented any extended tests being made. Many more applications for the process will be presented by the return of normal conditions. From observations already made, however, chrome plate has definitely taken its place in the gage industry, and when applied to a properly prepared gage and well finished it offers remarkable economies.

NEW DIES

GUY M. HARTSOCK

In the design and manufacture of automotive clutch and brake pedal brackets it is generally desirable that the length of the shaft bearing be greater than the thickness of the stock from which it may be made, in order to decrease wear and reduce the tendency toward cutting due to high bearing pressures.

The first stampings used for this purpose had the bearing either clinched or welded in place. Later it was found that a heel of sufficient length could be formed from the metal of the stamping itself to produce a good bearing. This method of producing a bearing of this type is best explained by taking some commonly used bearing as an example. We have chosen a clutch release bearing as illustrated one quarter size in Fig. 1.

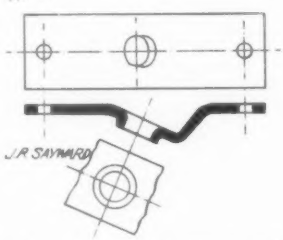


Fig. 1.—Clutch release bearing.

The part is made from rolled strip stock, the first operation being to cut to length, pierce attaching holes, and pierce hole for bearing. An ordinary progressive type die is used for this operation.

The bearing hole must be developed by experiment to the proper size to produce the necessary length of bearing at the finishing operation.

The second operation (see Fig. 2 for design of die) is performed while the part is still a flat stamping, and is to extrude the hole to the finished size and to a length sufficient to give the desired length of bearing after going through the finishing operation. This length must be considerably greater than the finished length, because of the fact that the radius A (Fig. 2) cannot be controlled. Sufficient stock must be allowed on the length of the hub to give the desired volume of metal to reshape to the proper size and shape in a later operation.

This length of hub may be roughly calculated by first determining the volume of a hollow cylinder representing the bearing, then assuming that the center of radius A is also the center of radius B (Fig. 2), calculate length C to represent an equal volume, the hole size being the same in both the first and second forming operations.

Fig. 2 requires very little explanation except as to the shape of the punch D. This punch, you will note, has two sizes on the working end, the lower step representing the size of the punch on the first operation and being used for location purposes only, and the second step representing the size of the finished hole. The shape of the radius D on this punch is very important as it determines the neck that may be drawn, and also has a great bearing on the cracking of the edges of the extruded collar. We would recommend that this punch be originally made with a 1/16" radius at point D, to be gradually increased by experimentation to produce the desired results.

Because of the tendency of a pierced hole to crack at its

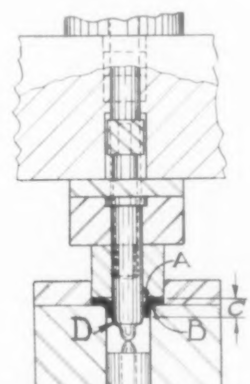


FIG. 2

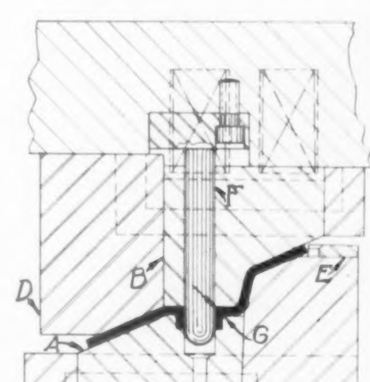


FIG. 3

Fig. 2.—Die for performing operation of extruding hole.

Fig. 3.—Die for shaping and sizing bearing and bending part to shape.

edges when stretched as in this operation, it is sometimes desirable to add a reaming operation prior to the first extruding operation, especially if the bearing to be produced is quite long in proportion to the size of the hole and the thickness of the stock. This reaming operation removes the minute checks caused by the piercing operation, and thus reduces the tendency for the metal to split when stretched.

The third operation, which compresses or "coins" and sizes the bearing and in this case also bends the part to its finished shape, is performed in a die as shown in Fig. 3. With this die in its open position and spring pads A and B at their extreme positions, the top of the lower pad A is flush with the top of the section C. Upper pad B in its open position is flush with, or projecting slightly beyond, lower face of section D.

This allows the part to be laid into the die flat, with the hub in the pocket of section A and the end in gage E. As the die closes the spring pads A and B clamp the work between their flat surfaces, then recede allowing the bending of the angles on the part to take place as the die is closing. At the end of the down stroke the excess length in the hub is pushed back to thicken the metal at section C, filling up all the space in the die around sizing pin F, thus producing a highly finished and very dense bearing surface, at the same time increasing the length of the bearing surface.

The diameter of sizing pin F must be a few thousandths over the finished size of the hole as shown on the part drawing, and must be determined by experimentation, as the hole closes in slightly (in this case around .002") upon withdrawal of the pin.

NEW MACHINES

HAROLD GILLER B. L. DIAMOND

The BAKER CONTOUR GRINDER is a specially designed machine to take care of all kinds of irregular shapes, both internal and external, giving a fine finish-ground surface without the need of polishing.

Baker Contour Grinder.

It is a small ruggedly designed machine, built with the accuracy required for present day manufacturing. The vertical wheel spindle is driven from a vertically mounted motor, which is well guarded for protection from grit and dirt.

The armature of the motor reciprocates, this motion being transmitted to the grinding wheel, which not only prevents shoulders from forming on the wheel, but gives a better cutting action, and obviously longer service. This reciprocating action is actuated by an independent motor, which is instantly controlled. This feature conserves the life of the wheel, and results in perfect work on radius, contour, sweep or straight die work, or on grinding other classes of work that would not be possible with a wheel not having the reciprocating feature. This action is secured through means of a cam mounted directly below the spindle driven by a small motor. When dressing the wheel, the reciprocation is instantaneously stopped by a conveniently located snap switch.

The table is at a convenient working height, and can be tilted at any desired angle in relation to the wheel for angle grinding. The table setting for this is quickly made with a pointer to desinate the angle.

The table is "in the clear." The size of the work is not limited as is the case with grinders operating from overhead motors on rear supports.

This machine is one that can be used to good advantage in every tool shop, especially where dies are made. As you know, dies and hardened inserts of all kinds warp after hardening. The installation of this machine permits the grinding of these odd shapes after hardening, thus assuring the toolmaker of procuring and maintaining a proper form. This machine is sold complete with motor and is equipped with a round table which can be tilted to the angle desired. Grinding wheels are mounted in a chuck hooked direct to the motor armature shaft, which shaft, through another mechanism is given an oscillating movement up and down, so that grooves will not be worn into the grinding wheel. You will note that the table is provided to receive a wheel truing device, whereby the wheel can be properly diamonded as required.

This machine has a floor space of 14"x14", and capacity of grinding wheels of ½" to 4" diameter with 2" face. This is size No. 2 and at present is only made in this size. Size No. 1 and No. 3 will be added later.

A radius grinding attachment can be furnished as extra equipment at a nominal price.

This machine is manufactured by Baker Brothers, Incorporated, of Toledo, Ohio, and is handled exclusively by Motch & Merryweather Machinery Company, Detroit, Mich.

OPERATION PLANNING

F. L. HOFFMAN

THIS section of this Journal will hereafter be reserved for the above subject.

In order to make this subject most beneficial and instructive it is necessary that every member of the Society contribute an article on operations, tooling, and the necessary equipment to produce various parts. This Journal is yours, and we as a Society are interested in what the other fellow is doing. Therefore, we urge an expression from you as to what you are doing.

To work efficiently we should have an abundance of material on hand at least a month before date of publication. I again urge you to come to the front and assist your editor in procuring material for the Journal.

In this issue, we are painting the background for a detailed study of operation planning.

I. ENGINEERING.

The first step in producing new parts originates in the engineering department. In automobile engineering, the original may be a wooden model built to scale and touched up in various places by adding modeling clay to produce new lines. These models may be placed in wind tunnels to check up the lines under wind pressure, and if incorrect will again be touched up with clay to overcome faults which this test may reveal.

The model is then used in the drafting room for producing sheet metal drafts in the case of body drafting and also for chassis layouts. The metal drafts are made on aluminum sheets surfaced with a white lacquer which will allow lines to be inked in.

During the process of producing drafts many questions arise which the previous drawing will not clearly define. Full size models of wood are then made and again clay may be modeled to clear up the point in question.

After these metal drafts are completed, detail drawings are made on vellum paper or tracing cloth, and are then reproduced on blue print paper for further use in the experimental department for producing the experimental body.

(*Continued next month*)

HISTORY OF THE TWIST DRILL

H. A. BOKRAM AND E. P. HORAN*

As our hairy progenitors swung from limb to limb, it may be imagined that they found it difficult to keep their personal effects about them. Obviously they must have felt the need for attaching a thong or string to their stone hatchets.

Therefore, it must have been at precisely that moment that the drilled hole and the drill were invented. Necessity was ever the mother of invention.

Retracing our steps to the uttermost limits of that prehistoric time, we find indisputable traces of the knowledge of drilling. Those tell-tale drill holes are limited to the early remains of no single country or people. In the bogs or claps of Europe and England, in Ireland and in North and South America, we have striking evidence of a comparatively expert knowledge of the art of drilling which, in each case, dates back and seems to be contemporary with the earliest records of mankind.

We have already hinted that it is more than probable that the knowledge of and need for drilling arose with the earliest recognition of the right of ownership. The first forward steps of civilization required that holes be drilled, and that articles of offense, defence, and worship might be attached to the person. Indeed, it may be supposed that man learned of fire through the frictional heat caused by drilling .

Of all early drills, the shaft drill is the most common and may rightly be regarded as the father of all drills, including even our modern twist drill. The tube drill of hammered copper used for the drilling of large holes may be a competitor for the degree of antiquity, but certainly the shaft drill was more generally used by all peoples.

The general impression seems to be that primitive drilling required infinite patience. Practical experiments, however, disprove this view, and while some few relics may have required hours or even days to complete, in general, no such time was required.

Starting with the shaft drill of wood or stone—later provided with the shaft of wood and the lashed point of stone, iron, or copper—we see the development of the drill pressed upward through the strap drill, the bow drill, the pump drill, and so up to our modern high speed twist drill.

It is interesting to observe that the development of the drill is very largely a matter of the increased speed imparted to it.

As we have said, the bow drill was common to all people. The next step, the strap drill, was well known to the Greeks and to the Egyptians from the earliest times, and even to the Brahmans of India. Homer, himself, refers to it as he describes the killing of the Giant Polyphemus, and we have exact record of the fact that the strap drill with disk or flywheel in conjunction with it was used in Egypt from the earliest time.

Columbus and De Soto reported that American natives drilled pearls by means of heated copper and careful investi-

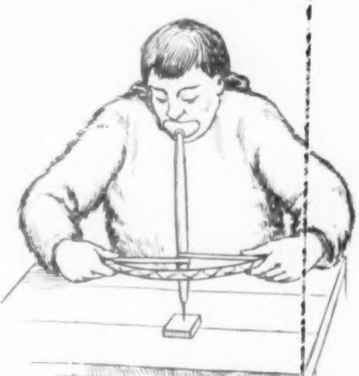


Fig. 1.—Alaskan bow drill.

*Cleveland Twist Drill Co.

NEWS OF INDUSTRY

E. R. DeLUIZ

March Passenger car sales figures for 24 states and the District of Columbia show a decrease of approximately 17.75 per cent under registrations for the same states in 1932, an announcement from R. L. Polk & Company indicates. The really interesting thing about these figures, however, is the fact that five states and five makes of cars actually show a gain over March of last year. Considering that this was done in the face of bank holidays and all other obstacles the achievement is considered remarkable. The states showing gains are Arkansas, Florida, North Carolina, Oregon, and South Carolina, while the makes showing increases are Dodge, Plymouth, Ford, Rockne, and Austin.

Hudson Motor Car Company announces its entry into the light delivery car field with its new line of three-and-a-half ton vehicles on the Essex Terraplane chassis. This chassis is identical with the chassis of the Terraplane Six passenger car. The delivery line is available in three popular body types.

Dodge dealers sales took another forward spurt during the week ending April 8, the factory sales department announced. Retail deliveries of Dodge passenger cars were 8.3 per cent higher than during the preceding week.

Abandonment of the Ford Motor Company's assembly plant in Cleveland is indicated by the dismantling of the plant and shipment of tools and other equipment to Ford production units in other cities. It is said the changes in Cleveland,are a part of a nationwide adjustment being made by the Ford company, due to present business conditions.

"No man with an honest product to sell need be afraid of the future. And no man with a hard earned dollar to spend should be afraid to spend it." Such was the statement made recently by Walter P. Chrysler following the announcement of the DeLuxe Plymouth Six, a slightly higher priced line in addition to the present line of Plymouth automobiles. Mr. Chrysler went on, "There is no patent remedy that will bring prosperity back to America. The only way that industry can regain its normal stride is by the introduction of products of such outstanding value that the public will buy in increasing numbers, thus placing money in circulation and clearing the clogged channels of trade."

R H. Scott of the Reo Motor Car Company announced recently that an automotive improvement of revolutionary character, ranking in importance with the self starter, has been put into production by Reo and will be announced to the public within a short time. While there is no definite word being given out as to what this invention is, there are rumors that the new Reo will be a car without a gear shift lever.

Arthur J. Chanter, who since August, 1928, has actively managed the Pierce Arrow Motor Car Company as first vice president and general manager, has been elevated to the presidency at a recent meeting of the board of directors.

With the arrival of Walter F. Brown, former U. S. postmaster general, in Toledo, to assist in the reorganization of the Willys Overland Company, announcement has been made that employment at the plant has been increased to 1,800. Rush to fill an order for 4,400 International trucks, plus an increased demand for Willys Overland passenger cars in the export market has boosted employment to the 1800 mark. It is expected that the number of employees will shortly be increased to 2500.

Detroit Engineering Society—39th Annual Meeting advanced to Wednesday, May 3, 1933, at 6:30 P.M. in the ballroom, Hotel Fort Shelby. Speaker: Mr. Charles F. Kettering. Topic: "An Engineer's Viewpoint of an Ancient Civilization." Illustrated with movies of his recent Mexican trip. Public invited. Dinner reservations at $1.00 each must be made not later than next Tuesday. If you cannot come to dinner, make reservation for seat after dinner.

E. L. Brandt,
Phone COlumbia 5320. Managing Secretary.

A.S.T.E. NEWS

LOLA CORBIN S. R. READ

If at any time you have some work requiring the services of a commercial artist, and wish capable work at reasonable rates, call on our Art Editor, Mr. Hans Hansen. The art work in this issue of the Journal is a specimen of his efforts. To get in touch with Mr. Hansen write or phone A.S.T.E. Journal, 8316 Woodward Ave., Madison 2057.

Mr. M. A. Atlas, president of the Mechanical Engineering Co., has joined the ranks of the benedicts. The marriage of Mr. Atlas to Blanche A. Gilmore was solemnized at the Central M. E. Church, Detroit, on April 20th, and the newlyweds are at home to their friends at 19077 Hanna Avenue, Melvindale, Michigan.

The members of the A.S.T.E. extend their congratulations and best wishes.

For some of our members, the banking holiday must have been a "boom"—our friend Max T. Schiebold, of Gemmer Mfg. Co., Detroit, is sojourning at Vero Beach, Fla.

T. B. Carpenter, General Motor Truck Co., of Pontiac, Michigan, goes on his vacations early in the season. He is receiving mail at Lake Orion until further notice.

Our Secretary, Mr. A. M. Sargent, has made several trips down into Southern Ohio of late—we certainly hope it means "big business."

Note—If any of you members have "anything of a personal nature" which you wish to "broadcast," just call Mad. 2057.

STANDARDS

F. H. HARTLEP

The relationship of standardization to scientific management is clearly explained in the following extract from a report by Mr. M. I. Cooke of the Carnegie Foundation for the Advancement of Teaching.

"A standard under modern scientific management is simply a carefully thought out method of performing a function, or carefully drawn specification covering an implement, some article of stores or of product.

"The idea of perfection is not unvalued in standardization. The standard method of doing anything is simply the best method that can be devised at the time the standard is drawn. Improvements in standards are wanted and adopted whenever and wherever they are found.

"There is absolutely nothing in standardization to preclude innovation, but to protect standards from changes which are not in the nature of improvements there should be certain safeguards. All that is demanded under modern scientific management is that a proposed change in a standard must be scrutinized as carefully as the standard was scrutinized prior to its adoption; and further that this work be done by experts who are as competent to do it as were those who originally framed the standard.

"Standards adopted and protected in this way produce the best that is known at any one time. Standardization practiced in this way is a constant invitation to experimentation and improvement."

NITRIDED NITRALLOY

Nitriding is the name applied to a process in which special steels are case hardened with ammonia gas instead of substances which introduce carbon into the surface of the steel (case-carburizing). Nitralloy is the trade name of special steels selected for use in the nitriding process because they show the maximum surface hardness when exposed to ammonia gas under definite conditions.

This produce is of special interest and represents a very important metallurgical development. In the regular case-carburizing processes temperatures of 1600 to 1700° F. are employed and the operation is often accompanied by more or less distortion. Subsequent heat treatment is necessary to harden and refine case and core. In the nitriding process, temperatures of only 900 to 1000° F. are used. Except in special cases the process is carried out at 950 to 975° F. It is obvious that there should be no distortion if machining and hardening strains have been removed. Furthermore, no further heat treatment is necessary after nitriding as this can be done previous to the operation itself. A case of maximum depth and ductility can be produced with a hardness superior to that of case-carburized material. In fact, at the sacrifice of some ductility a case can be produced having a Brinnell hardness in excess of 1000. It will scratch glass. Testing files are worn smooth without affecting the hard surface. This hardness is retained to a remarkable extent at elevated temperatures.

Another important advantage for many purposes is the superior resistence to atmospheric, plain and salt water corrosion as compared with ordinary steel. The alloying constituents of Nitralloy give it toughness and high shock-resisting properties. It forges and machines satisfactorily in both the annealed and heat treated condition. When nitrided it has been found in service to possess unusual wearing qualities. In the aviation industry, for instance, it has been found that during 100 hours' operation, nitrided cylinders showed no wear, whereas heat treated steel cylinders showed a wear of 0.003 to 0.004 inch. Oil consumption in the heat treated steel cylinder motor increases 300%, whereas it remained constant in the nitrided cylinder motor.

The applications of this product are too numerous to mention in their entirety. Following, however, are some of them: anvils, bushings, cams, chucks, clutches, cylinders, dies, gauges, gears, steering mechanism, steam nozzles, pinions, wrist pins, rollers, spinning rings, cam shafts, pump shafts, and spindles.

Industrial Bulletin,
Arthur D. Little, Inc.

MANUFACTURING ECONOMICS

G. F. PETERSIMES

Because of a late decision to include a department in this Journal called Manufacturing Economics and the consequent lack of time to get suitable material prepared, we regret that we have nothing available for publication in this department at the present time.

Mr. G. F. Petersimes is the newly appointed editor of this feature. Among the subjects to be discussed in this space in the future are new developments in time and motion study, current industrial practice in regard to machinery versus men where manufacturing costs are equal, and new savings effected through scientific management and organization.

gation seems to indicate that the Assyrians knew and used the principle of the wheel drill prior to 3000 B. C.

All records apparently indicate that holes were bored in primitive times from opposite sides, the hole being started by chipping a small depression, that the drill-point might be held true.

Reference to early American writing strongly indicates that the North American Indian, at the time of the advent of the Whites, was ignorant of all drills except the plain shaft drill revolved between the extended palms of the hands, the drill-points being made of marble or quartz.

Early Egyptian paintings indicate that the principle of the brace and bit was, by no means, unknown.

The Malays are accustomed to bore gun barrels in the following manner: A bamboo basket filled with stones is placed upon a huge shaft drill which is held by a cross piece of bamboo. The gun barrel to be bored is buried upright in the ground and two boys turn the drill after the manner of the old time grist mill. These gun barrels are made in pieces about one foot long, and are first bored small and then welded together upon an iron rod. The hole is afterwards increased in size and an entire gun barrel is easily made in three days.

The strap drill consists of a revolving shaft, a head piece held in the mouth or by the hand which holds the shaft in

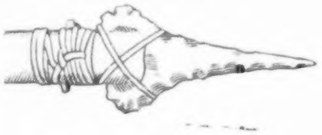


Fig. 2.—Point of bow drill.

position, and the strap by which the shaft is revolved. This drill has been used by the Eskimos to our accurate knowledge for over 300 years. The strap drill lends itself to comparatively heavy boring and may have originated in either Japan, Siberia, or Europe.

The bow drill is a development of the strap drill.

The pump drill differs from other boring tools and was popular with early people in all parts of the world, being found among relics of Europeans, early Mexicans, Laplanders, Chinese, and the inhabitants of the Pacific Islands.

The bow of the pump drill has a hole in its center through which the shaft is allowed full play as it is lowered and raised in working. The bow string is tied around the ends of the cross piece, and a disk is attached to the lower end of the shaft, lending a fly-wheel action necessary to carry the shaft over dead center. A gradually increasing downward pressure on the cross-piece unwinds the string from the shaft and imparts a whirling motion to the drill. Just as the string is unwound, the pressure is released and the disk imparts sufficient impetus to rewind the string in the reverse direction, whereupon the movement is renewed as described above. Pump drills of this type are found in use well up into modern times, and but a few years ago were quite generally used for lighter drilling.

And so the early history of the drill progressed—from shaft drill to strap drill, from strap drill to bow drill, and so on through constant minor betterments up until 1860 or

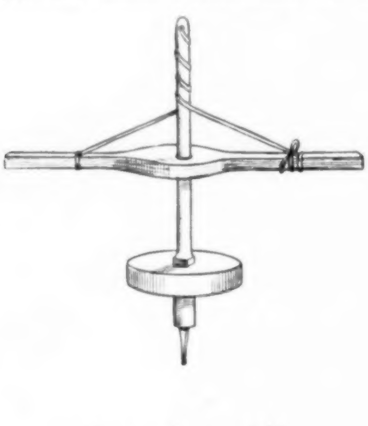


Fig. 3.—Pump drill.

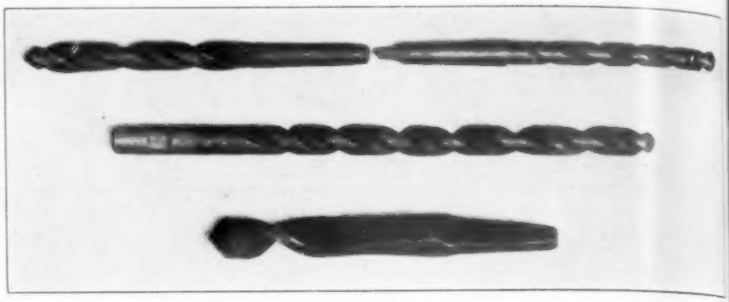


Fig. 4.—Original forged drill.

thereabouts, at which time our modern twist drill came into use.

The first twist drills were roughly forged by hand in individual shops, and like nearly all new machines and devices, were the product of evolution. They were probably first used for drilling holes deeper than the flat, or chisel-pointed drills, then in common use, could handle satisfactorily.

These flat drills were simply more or less rough bars of steel flattened and angularly pointed at one end. They were fairly satisfactory in drilling shallow holes through thin material, but in deeper holes they did not bring out the chips, or in fact, allow them to come out, as the area, or displacement, of the drills increased so greatly just back of the flattened end as to almost fill up the hole. The chips would therefore pack around the drill point, heat was produced, and the drilling was seriously interfered with. With the first twist drill this trouble was in great measure overcome.

Although twist drills and flat drills have something in common—both cut only on the end, where they have two cutting edges of equal length placed opposite to each other—the twist drill, by reason of its distinctive shape, has three pronounced advantages over its predecessors:

1. The grooves of a twist drill not only provide an opportunity for the chips to get out of the hole, but, on account of their being cut on a spiral, they tend to pull the chips out.

2. The cutting faces of the flat drill were perpendicular to the direction of the cut, while those of a twist drill are at an acute angle. This "rake" gives to the cutting edges of a twist drill an easy "entrance angle" with decreased resistance to the cut and, in addition, a wedge-like action which helps to feed the tool. A twist drill, therefore, requires considerably less power than a flat drill doing the same amount of work.

3. The twist drill on account of its substantially uniform shape from end to end of the fluted part can be sharpened repeatedly on the point without materially reducing it in size or impairing its efficiency, while after a very few sharpenings the old style chisel-pointed drill had to be entirely remade.

No comparison of these two types of drills would be complete if it failed to call attention to the great superiority of the twist drill so far as accuracy in its work is concerned, due largely to continued improvements in machinery and methods of manufacture. Flat drills were rough tools at best, not many of them running even approximately true, while the majority of twist drills are now finished after hardening by methods which put them almost in the precision class.

This briefly is the history of the twist drill, a tool which antedates history itself and from the earliest day to this moment has probably shown less radical development than has any other modern instrument or tool; for our modern drill does little more than substitute for stone, a more convenient or efficient handle, and steam or electric drive to increase the rapidity of rotation, while the principle remains exactly the same as that used by our Stone Age ancestor in drilling the holes in his stone hatchet.

Fig. 5.—Modern drill.